

## ENGINEERING MANAGEMENT SUPPORT INC.

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April 22, 1998

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Site:	
ID#	
By:	
Date:	

**SUBJECT : Draft Baseline Risk Assessment  
West Lake Landfill Operable Unit 1, Bridgeton, Missouri**

Dear Mr. Kinser,

On behalf of Cotter Corporation (N.S.L.), Laidlaw Waste Systems (Bridgeton), Inc., Rock Road Industries, Inc., and the United States Department of Energy (the "Respondents"), Engineering Management Support Inc. (EMSI) submits the enclosed draft Baseline Risk Assessment (Appendix A to the Remedial Investigation [RI] Report) for Operable Unit 1 of the West Lake Landfill. We have also enclosed Sections 9 and 10.4 of the RI, which are summaries of the results and conclusions presented in the draft Baseline Risk Assessment. In addition, we have included a revised Table of Contents for the RI. Please replace the Table of Contents and insert Sections 9 and 10.4 in your copy of the draft RI.

If you have any questions please do not hesitate to contact me.

Sincerely,  
ENGINEERING MANAGEMENT SUPPORT, Inc.

  
Paul V. Rosasco, P.E.

Enclosures

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## 9.0 BASELINE RISK ASSESSMENT

A draft Baseline Risk Assessment (BRA) for Operable Unit 1 has been prepared by Auxier & Associates (Auxier) in coordination with EMSI on behalf of the OU-1 Respondents. The BRA is included as Appendix A of this RI report. This section of the RI presents a brief summary of the results and conclusions reached by Auxier as presented in the BRA. Specifically, this section of the RI presents a summary of the following key BRA tasks:

- Selection of Chemicals of Potential Concern
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization
- Uncertainty Assessment
- Ecological Assessment

The first five of these tasks are part of the evaluation of potential risks to human health. The final task is an assessment of potential impacts to possible ecological receptors that may be present at or near the landfill.

### 9.1 Human Health Evaluation

A quantitative assessment of potential risks to human health was developed by Auxier in accordance with EPA's guidance for human health risk assessments (EPA, 1989). This assessment included the following:

- Identification of Chemicals of Potential Concern (CoPCs);
- Evaluation of potential exposure scenarios;
- Assessment of the toxicity associated with the radiological and non-radiological CoPCs present in OU-1;
- Characterization of the potential risks to human health posed by the CoPCs in OU-1; and
- Discussion of the uncertainties associated with the risk characterization effort.

### 9.1.1 Chemicals of Potential Concern

The first step in the risk assessment process is to identify the CoPCs for which the associated potential risks will be assessed. Contamination at the landfill consists of two localized areas containing radioactive materials associated with naturally occurring uranium-238, uranium-235, and thorium-232 decay series. The radionuclides with relatively long half-lives were selected as indicators of all of the members of the three radioactive decay series and used as radiological CoPCs. In addition, as with any solid waste landfill, organic and inorganic chemicals are present within the solid waste materials and associated leachate. Based upon an evaluation of the concentrations and toxicity of the organic and inorganic chemicals detected in the landfill materials, Auxier identified non-radiological CoPCs. The radiological and non-radiological CoPCs selected by Auxier for consideration in the human health risk assessment are summarized on Table 9-1.

### 9.1.2 Exposure Assessment

The potential for health effects from exposure to site-related contaminants were estimated for receptors located onsite and in offsite areas potentially affected by releases from OU-1. Based upon an assessment of the characterization data describing the source term, existing access controls, and the current and projected future land uses, hypothetical receptor scenarios were selected for risk characterization. These potential receptors included a landfill groundskeeper working adjacent to Areas 1 and 2 (current), an onsite groundskeeper working on Areas 1 and 2 (future) and an offsite (Ford property) groundskeeper (both current and future). Residential receptors anywhere on the landfill or commercial building users or construction workers on Areas 1 and 2 were not evaluated due to existing deed restrictions on current and future land uses that restrict these uses. Other potential onsite receptors such as a trespasser on Areas 1 and 2 or other landfill workers, commercial building users, or construction workers outside of Areas 1 and 2 were also considered; however, it was concluded that the groundskeeper scenarios (adjacent to Areas 1 and 2 under the current scenario or on Areas 1 and 2 under the future scenario) represented the greatest possible exposure potentials.

As no maintenance activities are currently being conducted in Areas 1 and 2, potential exposures to an onsite grounds keeper were not evaluated under the current exposure scenario. Potential exposures to a groundskeeper working in areas adjacent to Areas 1 and 2 were evaluated as part of the current scenario. Potential exposures associated with an onsite groundskeeper working in Areas 1 and 2 were evaluated as a possible future receptor scenario. Due to the presumed future direct access to Areas 1 and 2, the onsite groundskeeper scenario was selected as the most conservative scenario for evaluation of possible future impacts to other landfill workers. The offsite (Ford property) groundskeeper was considered to be both a potential current and future risk scenario.

The physical characteristics of the Site and postulated receptor behavior were used to identify potential exposure pathways to the hypothetical receptors. The potential exposure scenarios identified by Auxier for evaluation in the risk assessment included the following:

- Exposure to external radiation;
- Inhalation of dust and gas;
- Dermal contact; and
- Incidental ingestion of soil.

These hypothetical exposure pathways were combined with the results of the toxicity assessment to characterize the potential risks posed by OU'-1.

#### 9.1.3 Toxicity Assessment

The toxicity assessment determined the mode of toxicity of the various CoPCs, that is carcinogenic and systemic toxicity, and provided a quantitative measure of the toxicity. Toxicity profiles including carcinogenic slope factors and chemical reference doses were developed for each of the CoPCs.

#### 9.1.4 Risk Characterization

Maximum credible risks were calculated for hypothetical current receptor scenarios including a groundskeeper performing maintenance activities adjacent to Areas 1 and 2 and a groundskeeper on the adjacent Ford property. The carcinogenic risks to each of these hypothetical receptors were estimated to be within the generally acceptable EPA target risk range of  $10^{-6}$  to  $10^{-4}$  (Table 9-2). The dominant exposure pathway for these receptors was determined to be external radiation exposure from radionuclides in soil. No adverse systemic toxic effects resulting from the presence of non-radionuclide constituents were indicated by this assessment.

The Ford property groundskeeper and the onsite groundskeeper working in Areas 1 and 2 receptor scenarios were also evaluated under projected future conditions. The results of the baseline risk assessment indicated that credible risks to onsite and offsite receptors, represented by the groundskeeper working in Areas 1 and 2 and the Ford property groundskeeper scenarios, are also within the generally acceptable EPA target risk range of  $10^{-6}$  to  $10^{-4}$ . Auxier concluded that these receptors are not expected to be at risk from radiologically impacted materials in OU'-1.

Non-radiological contaminants are unlikely to cause an unacceptable risk to human health under future conditions for any of the onsite receptor scenarios evaluated. Adverse systemic (non-carcinogenic) health effects are not expected, as the calculated hazard indices for non-radiological CoPCs were less than one.

#### 9.1.5 Uncertainty Assessment

The purpose of the uncertainty assessment is to identify those types of input to the risk assessment that have the greatest potential to affect the results, and evaluate the relative potential impact of those inputs on the results of the risk assessment. The areas of uncertainty identified for the OU-1 risk assessment include the following:

- Definition of the location and extent of the radiological materials;
- Characterization of the radiological source term;
- Measured or estimated quantities and concentrations;
- The conceptual model for OU-1;
- Calculations, models and numerical parameter values used for OU-1; and
- Areas, factors or other items for which limited or no information are available.

The relative potential impact of these uncertainties on the results of the risk assessment and the projected direction (conservative, that is tending to over-estimate the projected risks, or liberal, that is to under-estimate the potential risks) of the bias introduced by the identified uncertainties were estimated for the risk assessment. The results of these estimates are summarized on Table 9-3. Overall, it was concluded that the estimates of potential human health risks were conservative, that is the evaluations tended to over-estimate the potential risks to human health.

#### 9.2 Ecological Evaluation

Consistent with EPA guidance (EPA, 1997), the ecological risk assessment used a phased approach to evaluate the potential risks to ecological receptors potentially exposed to chemicals in environmental media associated with OU-1. During the initial step, problem formulation was used to define the scope of the risk assessment. Based on the results of the problem formulation phase, it was concluded that terrestrial ecological receptors may be exposed to chemical contaminants in various environmental media including soils, surface water and air.

Exposures to representative wildlife species via the various pathways were estimated and the total daily exposure was calculated for each receptor species. Based upon a comparison of these intakes to toxicity information, it was determined that contaminants present in OU-1 may have an adverse effect upon the environment (Table 9-4). Plants, soil invertebrates such as earthworms, small wildlife species and mammalian predators may be adversely impacted as a result of exposure to the contaminants including the metals arsenic, cadmium, chromium, copper, lead, selenium, and uranium present in the surface and near-surface soils.

Although the results of the ecological risk assessment indicate that a potential impact to wildlife may exist, the conservative nature of the risk assessment assumptions undoubtedly result in an over-estimate of the actual risks that may be posed by Areas 1 and 2. One of the most significant sources of uncertainty potentially contributing to an over estimate of the possible risks to ecological receptors is the use of the maximum detected value as the basis for the exposure concentration. For example, the majority of the estimated risks calculated for Area 1 result primarily from selenium and to a lesser extent nickel and chromium. Occurrences of high levels of these metals are associated with a single sample result, the surface sample obtained from boring WL-114. This sample contained selenium and nickel levels of 250 and 3,600 ppm respectively, which are substantially greater than the levels found in any of the other samples. Using the second highest levels detected for each of these contaminants, 1.8 and 73 ppm respectively, which are still substantially greater than all of the other sample results, yields substantially lower estimates of potential risk. Consequently, the calculated potential chemical risks are highly influenced by a few elevated trace metal results, that are not representative of the overall trace metal levels detected in the surface or near surface soils. As a result, the potential risk estimates calculated using the maximum values are only representative of the potential risks at a single sample location, and thus are extremely conservative and greatly overestimate the risks that may be present at the other locations in Areas 1 and 2.

It should also be noted that the areas of potential impact to wildlife are located within the landfill boundaries. Some of the ecosystems present at the West Lake Landfill are the result of existing institutional controls and other limitations on land-use within OU-1 which allow field succession to take place. As a result, any disturbance of the Areas 1 and 2, such as might occur with remediation activities, may significantly alter or destroy the habitats that currently exist, forcing wildlife present at the West Lake Landfill to migrate to other areas. In addition, increasing development of the land around the landfill has removed, and will continue to remove, significant amounts of wildlife habitat. This overall decrease in habitat area over time will result in some larger species leaving the area and reducing the overall ability of the area to support some types of wildlife.



Based on the results of the sediment and offsite soil sample analyses, erosion of surface soil from Areas 1 and 2 and subsequent sediment transport has resulted in offsite migration of radionuclides from Areas 1 and 2. Soil erosion and sediment transport is also considered to be a potential pathway for future migration of radionuclides from Areas 1 and 2 during extreme precipitation events.

#### 10.3.4 Leaching to Groundwater and Groundwater Transport

Perched water is present at isolated locations within the landfill materials in Areas 1 and 2. Very low levels of radionuclides at concentrations of approximately 1 to 2 pCi/l or less were detected in some of the perched water samples.

Perched water discharges from the landfill surface in the western side of Area 2. A sample of this leachate seep indicated that the radioisotopes present in the seep water were all below the Missouri State MCLs. Based upon these results, the leachate seep does not appear to be a significant migration pathway. Seepage discharge is not considered to be a significant pathway for offsite migration because the water from the seeps does not migrate offsite.

The levels of radionuclides detected in groundwater beneath and adjacent to Areas 1 and 2 generally were below both background levels and the State of Missouri MCLs. Only one well (D-6) contained radionuclides above the Missouri State MCLs and the measured concentrations in this well were just slightly greater than the MCL. Based on the relatively low solubility of radionuclides in water and their affinity to adsorb onto the soil matrix, leaching of radionuclides into groundwater and subsequent transport in groundwater to offsite areas is not considered to be a significant migration pathway.

#### 10.4 Baseline Risk Assessment

The Baseline Risk Assessment (BRA) identified eight radionuclides and their associated daughter products as Chemicals of Potential Concern (CoPCs) based on their relatively long half-lives. Four trace metals were also selected as CoPCs for the human health risk assessment. Based upon a comparison to EPA screening values, other trace metals and various organic compounds detected in the soil samples obtained from Areas 1 and 2 were not selected as CoPCs as the maximum detected values of these constituents did not exceed the risk-based screening levels.

Several potential human receptors were identified in the BRA including a groundskeeper currently working adjacent to Areas 1 and 2, a groundskeeper that may work on Areas 1 and 2 in the future, and a current or future groundskeeper working offsite on the Ford property. The potential pathways by which these receptors could potentially be exposed to contaminants present in Areas 1 and 2 included exposure to external radiation, inhalation of radon gas or dust containing radionuclides or other

constituents, dermal contact with impacted materials, or incidental ingestion of soil containing radionuclides or other chemicals. Potential for exposure to contaminated groundwater was not expected to be a significant pathway given the distance to the nearest drinking water well and the fact that all businesses and residences in the area use municipal drinking water supplies.

Based upon an assessment of the carcinogenic potential and systemic toxic effects associated with each of the CoPCs, combined with the exposure assessment scenarios, potential risks were calculated for each potential receptor. These calculations indicated that the potential exposure to external radiation for the hypothetical groundskeeper that currently could work adjacent to Areas 1 and 2 resulted in a carcinogenic risk of  $1 \times 10^{-6}$  for Area 1 and  $1 \times 10^{-5}$  (one additional cancer incidence per 100,000 people) for Area 2. These calculated risks were within the generally acceptable risk range used by EPA of  $10^{-4}$  to  $10^{-6}$ . No adverse systemic effects to the groundskeeper were identified. The potential risks to a hypothetical groundskeeper working on the Ford property adjacent to Area 2 resulted in a carcinogenic risk of  $2 \times 10^{-6}$  which is also within generally acceptable risk range used by EPA of  $10^{-4}$  to  $10^{-6}$ .

The potential risks to the future onsite groundskeeper working in Areas 1 and 2 were calculated at  $2 \times 10^{-5}$  for Area 1 and  $7 \times 10^{-5}$  for Area 2, both of which are within the generally accepted risk range of  $10^{-4}$  to  $10^{-6}$  used by EPA. As with the current exposure scenario, the calculated risk for a possible future exposure for a hypothetical offsite groundskeeper receptor ( $6 \times 10^{-6}$ ) were within EPA's generally accepted risk range. Non-radiological CoPCs are not projected to cause unacceptable risks under either the current or future exposure scenarios. Uncertainties associated with the human health risk assessment were addressed through the use of conservative assumptions likely resulting in an overestimate of the actual risks that may occur.

The ecological assessment indicated that contaminants present in OU-1 might have an adverse impact upon the environment. Plants, soil invertebrates, small wildlife species and mammalian predators may be adversely impacted as a result of exposure to contaminants, including trace metals, present in OU-1 soils. It should be noted however, that some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. As a result, any disturbance of the landfill such as might occur with remediation activities may significantly alter or destroy the habitats that currently exist forcing wildlife to migrate to other areas. In addition, increasing development of areas around the landfill has, and will continue to remove significant amounts of wildlife habitat forcing some larger species to leave this area and reducing the overall ability of the area to support some types of wildlife.



Table 9-1 : Chemicals of Potential Concern (CoPCs) for Human Health Risk Assessment

Radiological CoPCs

Uranium-238 (for uranium-238 and 2 daughters)

Uranium-234

Thorium-230

Radium-226

Lead-210

Uranium-238 + Uranium-234 / 2 \* 0.05 (for Uranium-235 and one daughter)

Protactinium-231

Thorium-232

Non-Radiological CoPCs

Arsenic

Beryllium

Mercury

Nickel

Bis(2-ethylhexyl) phthalate

Di-n-butyl phthalate

Di-n-octyl phthalate

2-Methylnaphthalene

Phenanthrene

Aldrin

Dieldrin

Aroclor 1242

Table 9-2: Summary of Calculated Risks for Current and Future Potential Receptors

<u>Potential Receptor</u>	<u>Location</u>	<u>Radionuclide Cancer Risk</u>	<u>Chemical Cancer Risk</u>	<u>Total Cancer Risks</u>	<u>Hazard Quotient</u>
<b>Current Scenarios</b>					
Grounds keeper adjacent to Area 1	Onsite	$3 \times 10^{-6}$	NE	$3 \times 10^{-6}$	NE
Grounds keeper adjacent to Area 2	Onsite	$1 \times 10^{-5}$	NE	$1 \times 10^{-5}$	NE
Ford property grounds keeper	Onsite	$2 \times 10^{-6}$	$6 \times 10^{-8}$	$2 \times 10^{-6}$	0.0002
<b>Future Scenarios</b>					
Area 1 grounds keeper	Onsite	$2 \times 10^{-5}$	$5 \times 10^{-8}$	$2 \times 10^{-5}$	0.0009
Area 2 grounds keeper	Onsite	$7 \times 10^{-5}$	$7 \times 10^{-9}$	$7 \times 10^{-5}$	0.0003
Ford property grounds keeper	Offsite	$6 \times 10^{-6}$	$9 \times 10^{-8}$	$6 \times 10^{-6}$	0.0002

NE = No exposure

Table 9-3: Uncertainties Associated with Estimated Human Health Risks for OU-1

<u>Source of Uncertainty</u>	<u>Potential Impact on Estimated Risks</u>	<u>Impact on Health Protectiveness</u>
Extent of OU-1 areas	Low	Increases Protectiveness
Heterogeneity of waste form	High	Increases Protectiveness
Bias in sampling	High	Increases Protectiveness
Inclusion of natural background	Low to moderate	Increases Protectiveness
Calculation of 95% UCL	Moderate	Increases Protectiveness
Current and future land use as commercial industrial	None	None
Current and future receptors as occupational	None	None
Source release and environmental transport mechanisms	Low	None
Radon release model	Low	Increases Protectiveness
Future receptor exposure mechanisms at points of contamination	Low	None
Approximating exposure with simplified expressions	Moderate to high	Increases Protectiveness
Change in individual parameter values	Low to moderate	Generally increases Protectiveness
Slope factors and reference doses	High	Increases Protectiveness
No reference doses for some contaminants	Moderate to high	Decreases Protectiveness
External exposure source geometry	Moderate	Increases Protectiveness
Representative contaminant concentrations	Moderate	Increases Protectiveness

Table 9-4: Summary of Estimated Ecological Risks for Operable Unit 1

<u>Receptor</u>	<u>Hazard Quotients<sup>1</sup></u>	<u>Primary Contributors<sup>2</sup></u>
<b>Area 1</b>		
Plants	547	Selenium and nickel
Invertebrates	152	Arsenic, chromium, copper, mercury, nickel and selenium
White-footed mouse	3,320	Selenium, arsenic and copper
Cottontail rabbit	5,750	Selenium, arsenic and copper
American Robin	16,000	Selenium, copper and cadmium
<b>Area 2</b>		
Plants	347	Uranium, chromium and lead
Invertebrates	144	Chromium
White-footed mouse	647	Selenium, lead and arsenic
Cottontail rabbit	1,700	Selenium and arsenic
American Robin	15,300	Selenium, lead, cadmium and chromium
<b>Areas 1 and 2</b>		
Red fox	154	Cadmium, selenium and arsenic
American woodcock	442	Lead and selenium
Red-tailed hawk	12.2	Selenium

1. As discussed in the text, the hazard quotients presented above are considered over-estimates of the potential risks.
2. These compounds were identified in the Baseline Risk Assessment as the primary contributors of risk to each of the potential receptor scenarios identified above. Occurrences of other chemicals present in OU-1 and 2 may also result in potential risks greater than the threshold values.